Self-Reported Eating Speed Is Associated With Overweight Among Chinese School-Children: A Cross-Sectional Survey

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Research Article

Keywords: Cross-sectional study, Overweight, Eating speed

Posted Date: April 9th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-388331/v1

Version of Record: A version of this preprint was published at Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity on July 14th, 2021. See the published version at https://doi.org/10.1007/s40519-021-01267-5.

Abstract

Purpose

This study aimed to examine the association between eating speed and overweight in Chinese school-children.

Methods

In all, 664 schoolchildren (10-12 y) from 3 primary schools participated in this study in China. Their height and body weight were measured. Information about eating speed and other lifestyle behaviors was collected using a self-administered questionnaire. Multivariable logistic regression model was used to estimate the odds ratio (OR) and 95% confidence interval (95% CI) for overweight.

Results

Data from 629 students were analyzed. 26.2% of participants reported they were eating fast. The prevalence of overweight (including obesity) was 22.9%, and the mean of sleep duration was 9.69 (SD= 0.63) hours (Table 1). In the multiple linear regression analysis, eating speed was negatively associated with BMI (B=-0.70; $P<0.05$) and TG (B=-0.16; $P<0.05$). In addition, participants who ate fast were more likely to be overweight (OR=1.81, 95% CI= 1.19 to 2.75) after adjusting for potential confounding factors.

Conclusions

This study indicates that eating fast is associated with overweight among Chinese school-children.

Level of evidence

Level V; cross-section descriptive study

Background

In recent years, the prevalence of childhood overweight and obesity is increasing rapidly in China [1, 2]. Childhood overweight or obesity may be associated with an increased risk of future chronic diseases such as cardiovascular diseases, diabetes and orthopedic problems [3, 4]. At the same time, some risk factors for being overweight or obesity have been identified, including high energy intake and low energy expenditure [5], physical inactivity [6], and sleep disorder [7]. Recently, eating speed has been identified as a potential independent risk factor for obesity or overweight, and accumulating studies indicates that eating quickly may play an important role in development of overweight and obesity. Ochiai et al. reported that eating quickly may lead to overweight and excess gains in anthropometric variables (including body mass index (BMI), % body fat (BF), waist circumference (WC), and waist-to-height ratio (WHtR) among schoolgirls [8, 9]. Lin et al. showed that eating quickly was independent associated with overweight and obese among pre-school children [10]. However, only one study had examined the association between

eating speed and obesity in a Chinese school child population [11]. Thus, it is important to evaluate the self-reported speed of eating based on quantitative data.

Therefore, the aim of this cross-sectional study was to investigate the associations between eating speed and overweight after adjusting for lifestyle factors among school children in China.

Methods

Priticipants

Data for this cross-sectional study were obtained from a school-based study, which aimed to examine the relationships between health-related behaviors and overweight/obese in children. This study was carried out in Ningbo city, Zhejiang province, China. In brief, this study contained a self-administered health questionnaire survey and a physical examination. A total of 664 aged 10-12 years schoolchildren (5th and 6th grades) from 3 primary schools were recruited by using a non-random convenience sampling in October 2018. Individuals data if they were had unbelievably BMI (□10 or □50) or missing body weight or height or eating speed data was excluded in this study. Finally, 629 students were analyzed in the presents study. This study was approved by the ethics committee of Ningbo Center for Disease Control and Prevention. Prior to the study, written informed consents was obtained from all participates and their parents/legal guardians.

Measures

Eating speed and other behaviors

We used the self-administered questionnaire survey method to assess the students' eating speed and other health-related habits during one 45-minute class period in their classroom. The following information was obtained from each participant: sex, age, parents' marital status, parents' education status, physical activity, sleep habits, dietary habits, cigarette use, alcohol use, television viewing, computer use and eating speed. The information regarding eating speed was collected according to the question: "How fast is your eating speed compared to others when you have ordinary meal?" The participants chosen from three categories: "slow", "medium", and "fast" [10-13]. Other details of questionnaire of the survey have been published [14]. **Measurements**

In the general health examination, the height and body weight of all participants were measured by trained research staff. Details of the examination have been described in a previous publication of our group [15]. Body mass index (BMI) was calculated using the ratio of weight/height^2 (kg/m^2). Overweight (including obesity) were defined according to age- and sex-specific cut-off points specified by the International Obesity Task Force (IOTF) [16, 17]. Central obesity was defined as waist-to-height ratio (WHtR) ≥0.48 for boys and WHtR ≥0.46 for girls [18]. Fasting blood samples were obtained from all participants, and triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were measured by

standard enzymatic methods on a Beckman Coulter AU 640 (Beckman Coulter, Tokyo, Japan). Dyslipidemia concentrations were defined as follows: TG concentration higher than 1.70 mmol/L; TC concentration higher than 5.18 mmol/L; HDL-C concentration lower than 1.03 mmol/L; and LDL-C concentration of 3.37 mmol/L or higher [19].

Statistical Analysis

Since 3.8% (24) participants who reported their speed of eating as “slow”, we divided all the participants into two eating-speed groups as follow: not fast (slow and medium) and fast. Continuous variables were summarized as means (standard deviations), and categorical variables were summarized as percentages. Differences in continues variables were examined using the *t*-test, whereas categorical variables were analyzed using a chi-square test. A multiple linear regression analysis was used to evaluate associations between the eating speed and BMI, WHtR and serum lipids. We used logistic regression analysis to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) of overweight/abdominal obesity by eating speed adjusted for age (year, continuous), sex, parents’ education level on college (none, one and both), watching television≧ 2 h/day (yes or no), and computer use≧ 2 h/day (yes or no). A two-tailed *p* value 0.05 was considered statistically significant. All analyses were performed using the PASW STATISTICS, version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

The analyzed sample was composed of 629 Chinese school children. The mean of age was 10.26 (SD = 0.45) years old, 45.0% were girls. Overall, 26.2% participants reported eating fast, 93.5% participants parents’ marital were married, 33.7% of participants parents had no college degree. Among all the students, the prevalence of overweight (including obesity) was 22.9%, and the mean of sleep duration was 9.69 (SD = 0.63) hours (Table 1). Table 1 also shows the association between lifestyle factors and eating speed. Subjects who ate faster were more likely to be boys, with higher BMI and WHtR, higher TG and TC. Compared with not eating fast, participants who were inclined to eat faster were also more likely to be overweight or abdominal obese, have more time spent on television and computer, to skip breakfast, and to smoking. However, no significant correlation was found between eating speed and dyslipidemia among children in the results of this study.

Table 1
Characteristics of participants by eating speed in the study

Variables	All (n = 629)	Eating speed		*P*-value [a]
		Not fast (n = 464)	Fast (n = 165)	
Girls, %	45.0	48.9	33.9	**0.001**
Age, years	10.26 ± 0.45	10.27 ± 0.46	10.25 ± 0.45	0.687
Height, cm	145.07 ± 6.93	145.09 ± 6.92	145.03 ± 7.00	0.924
Weight, kg	38.32 ± 8.62	37.81 ± 8.62	39.74 ± 8.49	**0.013**
BMI (body mass index), kg/ m^2	18.08 ± 3.12	17.83 ± 3.11	18.77 ± 3.06	**0.001**
WC (waist circumference), cm	63.62 ± 8.62	63.05 ± 8.46	65.21 ± 8.96	**0.007**
WHtR (waist-to-height ratio)	0.44 ± 0.05	0.43 ± 0.05	0.45 ± 0.06	**0.005**
TG (triglycerides), mmol/L	1.20 ± 0.63	1.16 ± 0.59	1.33 ± 0.73	**0.008**
TC (total cholesterol), mmol/L	4.37 ± 0.74	4.36 ± 0.73	4.40 ± 0.76	0.556
HDL (high-density lipoprotein), mmol/L	1.54 ± 0.39	1.55 ± 0.38	1.49 ± 0.39	0.105
LDL (low-density lipoprotein), mmol/L	2.40 ± 0.63	2.39 ± 0.63	2.44 ± 0.65	0.407
Overweight (including obesity), %	22.9	19.4	32.7	**<0.001**
Abdominal obesity, %	22.6	20.9	31.3	**0.008**
High TG (>1.70mmol/L),%	15.1	13.8	18.8	0.124
High TC (>5.18mmol/L),%	11.8	11.0	13.9	0.313
Low HDL (<1.03mmol/L),%	4.6	5.2	3.0	0.260
High LDL (≧ 3.37mmol/L),%	6.7	6.3	7.9	0.472

* SD, standard deviation; Data are presented as n (percentage) or mean ± SD, † During the past seven days; ‡ during the past 30 days.

[a] Statistical significance was assessed by analysis of independent-samples *t* test for continuous variables and by the chi-square test for categorical variables.

Variables	All (n = 629)	Eating speed		*P*-value [a]
		Not fast (n = 464)	Fast (n = 165)	
Dyslipidemia, %	27.2	26.3	29.7	0.399
Parents' marital status (married), %	93.5	94.6	90.3	**0.054**
Parents' education level on college				0.130
Both had a college degree ,%	45.9	47.2	42.4	
Only one of them had a college degree ,%	20.4	21.3	17.6	
None of them had a college degree ,%	33.7	31.5	40.0	
Physical activity†				
Moderate physical activity ≧ 1 day/wk, %	92.1	92.7	90.3	0.334
Muscle strengthening activity ≧ 1 day/wk, %	75.2	74.6	77.0	0.540
Cigarette use (yes) ‡, %	0.8	0.2	2.4	**0.006**
Alcohol use (yes) ‡, %	6.0	6.0	6.1	0.990
Sleep duration, h	9.69 ± 0.63	9.68 ± 0.62	9.72 ± 0.64	0.516
Breakfast skipping (breakfast consumption frequency ≦ 6 days/week), %	4.1	3.2	6.7	**0.057**
Watching television ≧ 2 h/day, %	7.9	6.3	12.7	**0.008**
Computer use ≧ 2h/day, %	5.7	4.1	10.3	**0.003**

* SD, standard deviation; Data are presented as n (percentage) or mean ± SD, † During the past seven days; ‡ during the past 30 days.

[a] Statistical significance was assessed by analysis of independent-samples *t* test for continuous variables and by the chi-square test for categorical variables.

A multiple linear regression analysis was applied to assess the associations of BMI, WHtR, TG, TC, HDL-C and LDL-C with eating speed are presented in Table 2. According to these findings, eating speed were negatively associated with BMI (B=-0.70; $P<0.05$) and TG (B=-0.16; $P<0.05$), after controlling for sex, age, physical activity, sleep duration, breakfast skipping, watching television, computer use, cigarette use and alcohol use.

Table 2
Regression analyses among the two eating speed groups and anthropometric profile

Variables	Eating speed	Model 1	Model 2	Model 3
BMI, kg/m^2	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	**-0.94 (-1.49, -0.04)**	**-0.75 (-1.29, -0.20)**	**-0.70 (-1.26, -0.14)**
WHtR	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	**-0.02 (-0.03, -0.01)**	-0.01 (-0.02, 0.00)	-0.01 (-0.02, 0.00)
TG, mmol/L	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	**-0.17 (-0.28, -0.06)**	**-0.16 (-0.27, -0.05)**	**-0.16 (-0.28, -0.04)**
TC, mmol/L	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	-0.04 (-0.17, 0.09)	-0.01 (-0.15, 0.12)	-0.03 (-0.17, 0.11)
HDL, mmol/L	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	0.06 (-0.01, 0.13)	0.06 (-0.01, 0.13)	0.06 (-0.01, 0.13)
LDL, mmol/L	Not fast eating (reference)	0.00	0.00	0.00
	Fast eating	-0.048(-0.16, 0.07)	-0.033(-0.15, 0.08)	-0.038 (-0.16, 0.08)

Model 1: uncorrected. Model 2: corrected for sex and age. Model 3: corrected for sex, age, physical activity, sleep duration, breakfast skipping, watching television, computer use, cigarette use and alcohol use.

Bold: $P < 0.05$

Table 3 shows the results of multivariable logistic regression analysis of eating speed and overweight. Compared with eating not fast, participants who ate fast were more likely to be overweight (OR = 1.81, 95% CI = 1.19 to 2.75) after adjusting for sex, age, physical activity, sleep duration, breakfast skipping, watching television, computer use, cigarette use and alcohol use. No significant correlation was found between eating speed and abdominal obesity.

Table 3
Multivariable-adjusted OR and 95% CI for the association of eating speed with overweight or abdominal obesity

	Eating speed	Model 1	Model 2	Model 3
Overweight (including obesity)	Not fast eating (reference)	1.00	1.00	1.00
	Fast eating	**2.02 (1.36, 3.01)**	**1.83 (1.22, 2.74)**	**1.81 (1.19, 2.75)**
Abdominal obesity	Not fast eating (reference)	1.00	1.00	1.00
	Fast eating	**1.72 (1.45, 2.58)**	**1.52 (1.01, 2.30)**	1.47 (0.95, 2.25)
Model 1: uncorrected. Model 2: corrected for sex and age. Model 3: corrected for sex, age, physical activity, sleep duration, breakfast skipping, watching television, computer use, cigarette use and alcohol use.				
Bold: $P < 0.05$				

Discussion

The association between eating speed and overweight among school-aged children has received relatively little attention in previous researches. Some studies have suggested that eating quickly has a role in obesity not only in adults [18, 20] but also in adolescents [8, 21, 22]. However, Leong et al. suggested that once women have reached mid-life, eating quickly does not increase the risk of obesity [23]. So the relationship between eating speed and overweight need more evidence.

Consistent with prior researches [8, 21, 22], our study showed that eating quickly was significantly associated with a higher BMI, a higher TG and a higher risk of overweight among children, even after adjusting for sex, age, physical activity, sleep duration, breakfast skipping, watching television, computer use, cigarette use and alcohol use. However, the small sample size in our study may affect the statistical efficiency, no significant relationships were found between eating fast and dyslipidemia, and abdominal obesity among children in our study. To the best of our knowledge, this present study is the first one to investigate the association between eating speed and BMI, serum lipids, overweight, and abdominal obesity among school children in China.

Precise mechanism linking eating speed and overweight is not well understood. However, one possible mechanism can partly explain this association. Some studies show that eating quickly may cause more energy intake [24, 25], while eating slowly may help to reduce energy intake [26]. This may be because more energy is ingested by fast eaters before the brain recognizes the signal of satiety [27]. As a result, people who eat quickly could lead to insulin resistance, obesity and metabolic syndrome [28, 29].

The present study also has some limitations. First, the cross-section study nature does not determine the temporal relationship between eating speed and overweight. Second, self-reported eating speed may have introduced measurement error. Third, the energy consumption was not controlled in the present study. Finally, we did not measure other aspects of eating behaviors, such as overeating [30], selective eating [31], eat timing [32], daily eating frequency [33] and eating out [34], which may also be related to the risk of overweight. Thus, further studies including more details about eating behaviors with prospective design are needed.

Conclusions

In summary, our data demonstrate that eating speed affects BMI and TG, and eating fast was associated with overweight among children. This present study suggested that modifying eating quickly to a relatively slower rate can help prevent overweight in children.

Declarations

What is already known on this subject?

Recently, eating speed has been identified as a potential independent risk factor for obesity or overweight, and a few studies indicates that eating quickly may play an important role in development of overweight and obesity. However, there were limits studies focus on the effect of eating speed on overweight or obesity in children.

What does this study add?

Our findings revealed that eating speed was negatively correlated with BMI and TG, and eating fast was associated with increased risk of overweight/abdominal obesity among children. Our results suggested that eating slowly may help prevent overweight in children.

Author Contributions Y. Z. and Q.-H. G. conceived and designed the study; Q.-H. G. and S. -X. L. collected, analyzed and interpreted the data; Q.-H. G. drafted the manuscript. S.-J. W. revised the manuscript. All authors read and approved the final article.

Funding This study was funded by grants from the Nature Science Foundation of Ningbo (NO. 2016A610181, 2018A610403), Ningbo Health Branding Subject Fund (PPXK2018-10).

Availability of data and material Additional data can on request be made available.

Compliance with ethical standards

Conflict of interest All the authors state that there is no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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